

The Application of Acoustic Measurements and Audio Recordings for Diagnosis of In-Flight Hardware Anomalies

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Abstract

In many cases, an initial symptom of hardware malfunction is unusual or unexpected acoustic noise. Many industries such as automotive, heating and air conditioning, and petro-chemical processing use noise and vibration data along with rotating machinery analysis techniques to identify noise sources and correct hardware defects. The NASA/Johnson Space Center Acoustics Office monitors the acoustic environment of the International Space Station (ISS) through periodic sound level measurement surveys. Trending of the sound level measurement survey results can identify in-flight hardware anomalies. The crew of the ISS also serves as a “detection tool” in identifying unusual hardware noises; in these cases the spectral analysis of audio recordings made on orbit can be used to identify hardware defects that are related to rotating components such as fans, pumps, and compressors. In this paper, three examples of the use of sound level measurements and audio recordings for the diagnosis of in-flight hardware anomalies are discussed: identification of blocked inter-module ventilation (IMV) ducts, diagnosis of abnormal ISS Crew Quarters rack exhaust fan noise, and the identification and replacement of a defective flywheel assembly in the Treadmill with Vibration Isolation (TVIS) hardware. In each of these examples, crew time was saved by identifying the off nominal component or condition that existed and in directing in-flight maintenance activities to address and correct each of these problems.

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